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IN THE APPLICATION

OF

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FOR AN

ELECTRICAL VEHICLE MOTOR

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ELECTRICAL VEHICLE MOTOR

CROSS-REFERENCE TO RELATED APPLICATION

This application claims the benefit of U.S. Provisional Patent Application Serial No. 60/240,989, filed October 18, 2000.

BACKGROUND OF THE INVENTION

1. FIELD OF THE INVENTION

The present invention relates to an electric driven vehicle and, more particularly, a vehicle which relies on a flywheel as an energy source, and still more particularly, to a flywheel-driven vehicle in which the flywheel contains batteries and acts as an electric motor.

2. DESCRIPTION OF RELATED ART

In conventional electrical vehicles(EV)s, range of travel is limited due to the inefficiency, size, and weight of the battery or batteries. The motor and the battery are separate components. This is true even in flywheel battery electrical vehicles(FBEV)s.

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U.S. Patent 5,427,194, issued on June 27, 1995, to E.L. Miller describes a flywheel with electric batteries mounted thereon for an electrical vehicle. Provision is made for maintaining balance of the flywheel through movable weights and magnetic suspension of the flywheel axle. A separate motor and a separate generator are provided along the flywheel supporting and rotating shaft. The present invention avoids the weight of the electric motor and generator by incorporating the motor into the rotating flywheel and its casing, which also serves as a generator when the vehicle descends a hill, thus avoiding the extra weight of a separate motor and generator.

U.S. Patent No. 5,212,026, issued on May 18, 1993, to D.E. Mitchell, describes a combination battery and flywheel for an EV, wherein a novel stacked multiple battery flywheel is employed. Separate electric motors are employed in this system, adding significant weight which is not part of the rotating wheel. In the present invention separate motors are not used, but the flywheel serves as part of an electric motor, thus, saving weight.

U.S. Patent No. 4,140,916, issued on February 20, 1979, to Yum describes a battery-containing flywheel for an EV which employs a separate driving motor driving the flywheel shaft. In the present invention separate motors are not used but the flywheel serves as part of an electric motor, thus saving weight. The present invention integrates a flywheel battery and motor into a single unit, thus saving considerable weight while making maximum torque available at all times.

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U.S. Patent No. 3,497,026, issued on February 24, 1970 to W.L. Calvert describes an electrical power system for an EV employing a battery-containing flywheel shaft which provides field poles on the inner side of the flywheel as part of an electric motor-generator. A variable ratio transmission employs a lower inner portion of the flywheel acting on a radially movable friction wheel. An armature is axially located with respect to the battery-containing flywheel so as to electromagnetically interact with the field poles located on the flywheel so as to act as a generator or use electrical power as a motor. A mechanical feedback system maintains the armature at a desired speed of rotation differing from the field poles mounted on the flywheel so as to slowly generate electric power to the batteries or slowly accelerate the flywheel to avoid overly rapid charging or discharging of the batteries. The present invention employs rotor field poles or windings on both the inner and outer surfaces of the battery of the battery-flywheel which electromagnetically interact with stator windings located on the housing and the removable cover of the housing. A constant flywheel speed is maintained during operation of the computer by selectively energizing rotor field windings and stator windings as controlled by a computer, voltage input to the windings remains constant. This is desirable in order to make maximum torque available to the FBEV upon demand. Whenever the vehicle slows, stops or is going downhill, the computer changes the rotor to an alternator and recharges the battery.

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UK Patent No. G.B. 2 255 152 A, published October 28, 1992, also describes an electrical power system for an EV employing a battery-containing flywheel shaft which provides field poles acting as a rotor on the inner side of the flywheel as part of an electric motor-generator. The stator windings are located inboard of the flywheel-mounted field poles. The flywheel is allowed to operate at various revolution speeds and may increase its speed during vehicle deceleration or descent. A large number of stator coils and rotor coils may each be selectively energized by means of a computer to maintain the flywheel at a constant high speed, once the motor is actuated. A constant flywheel speed is desirable in order to assure full vehicle acceleration power at any time is available. Whenever the vehicle slows, stops or is going downhill, the computer changes the rotor to an alternator and recharges the battery.

German Patent No. DE19502960 published August 1, 1996, UK Patent No. G.B. 2 128 946, published May 10, 1984, and German Patent No. 2,237,896 published February 14, 1974, are cited but each employs an electric motor separate from the battery-flywheel. None of the above inventions and patents, taken either singly or in combination, is seen to describe the instant invention as claimed.

SUMMARY OF THE INVENTION

The present invention provides a flywheel-type battery which is integrated within a motor useful for maintaining the flywheel at

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a constant speed when actuated. It is composed of three major structures: an outer housing having a cylindrical housing wall and bottom section located at the base of the cylindrical casing which supports an axially located bearing; a flywheel-battery having an axle and a rotor having a battery supported about its periphery and connected to the axle by flanges so oriented as to form a fan for movement of cooling air through the system; and a housing lid having a cylindrical wall depending therefrom and upper radial flanges to support and axially locate the bearing for the rotor axle.

The cylindrical wall of the housing lid is configured to fit within the inner wall of the peripheral battery of the battery-rotor. Rotor windings are located along the interior and exterior walls of the battery, making the battery casing, itself, the driving force of the motor. These windings are used to recharge the battery when the vehicle is in a condition of negative drive force(stopping, slowing down, and going downhill). The drive train adjusts the torque to the wheels as needed through a series of hydraulics similar to a conventional transmission, except upon slowing, stopping, or going downhill, the torque is sent back into the motor to turn it, by means of a computer, into a generator which will recharge the battery.

The FBEV motor of the present invention utilizes smaller, more efficient rotor coils than are currently being used in EV electric motors, but requires a greater number of them. It also requires smaller stator coils. A large number of stator coils and rotor

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coils may each be selectively energized by means of a computer to maintain the flywheel at a constant high speed, once the motor is actuated. This is desirable in order to make maximum torque available to the vehicle at any time for sudden acceleration. A hydraulic transmission system is driven by the axle of the flywheel to convert torque from the constant speed flywheel to desired vehicle motion, a feedback system, computer actuated, being available upon vehicle stopping, deceleration or descent to turn the flywheel motor to a power generator for recharging the rotating battery system.

Accordingly, it is a principal object of the invention to provide a new and improved electro-hydraulic driven vehicle which overcomes the disadvantages of the prior art in a simple but an effective manner.

It is another object of the invention to provide a battery flywheel for an electro-hydraulic driven vehicle which may be easily and efficiently manufactured and marketed.

It is a further object of the invention to provide a new and improved flywheel battery for an electro-hydraulic vehicle which is of durable and reliable construction.

It is still another object of the invention to provide a battery flywheel which is maintained at a high, essentially constant speed of rotation by a computerized control system.

It is yet another object of the invention to provide a high speed battery flywheel having an axle providing torque to a hydraulic transmission.

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It is still another object of the invention to provide a high speed battery flywheel wherein the battery is located around the periphery of the flywheel and connected to the rotating axle by radial struts so designed and oriented as to move cooling air through the flywheel housing.

It is yet another object of the invention to provide a plurality of relatively small rotor coils along the outer and inner walls of the peripheral battery and a plurality of relatively small stator coils along the inner wall of the conforming flywheel housing and the inner wall of the conforming flywheel cover so as to provide a motor-generator therefrom.

It is still another object of the invention to provide a computer controlled system to activate individual rotor and stator coils as required to develop and maintain the constant high speed of rotation of said battery flywheel motor-generator.

It is yet another object of the invention to provide a computer controlled system for turning said motor-generator from electric motor operating mode upon vehicle acceleration to electric generator mode upon vehicle deceleration or descent.

It is still another object of the invention to provide a constant high-speed battery flywheel capable of providing maximum torque at any time for sudden acceleration of the vehicle upon demand.

It is yet another object of the invention to provide a battery flywheel motor-generator which minimizes EMF interference with other vehicles and radio and communication equipment.

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It is an object of the invention to provide improved elements and arrangements thereof in an apparatus for the purposes described which is inexpensive, dependable and fully effective in accomplishing its intended purposes.

These and other objects of the present invention will become readily apparent upon further review of the following specification and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a diagrammatic, environmental, perspective view of an electrical vehicle motor housing according to the present invention.

Fig. 2 is a diagrammatic elevation view of the electrical vehicle motor housing of Fig. 1.

Fig. 3 is a diagrammatic plan view of the battery-flywheel of Fig. 2 showing inner and outer rotor windings.

Fig. 4 is a diagrammatic elevation view of the battery-flywheel of Fig. 3 further depicting outer rotor windings.

Fig. 5 is a diagrammatic plan view of the peripherally mounted battery of Fig. 2.

Fig. 6 is a diagrammatic section view drawn along line 6A-6A of the battery of Fig. 5, and including the battery support.

Fig. 7 is a diagrammatic perspective view of the exterior stator housing showing outer stator windings.

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Fig. 8 is a diagrammatic bottom view of the stator housing top assembly showing inner stator windings of Fig. 1.

Fig. 9 is a diagrammatic elevation view of the stator housing top assembly of Fig. 8 showing inner stator windings.

Fig. 10 is a diagrammatic detail view of a typical rotor winding coil and support of Figs. 4 and 9.

Fig. 11 is a side view in elevation of the rotor winding coil cleat of Fig. 10, absent the coil itself.

Similar reference characters denote corresponding features consistently throughout the attached drawings.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention overcomes the drawbacks of conventional EV's, i.e., range of travel is limited due to the inefficiency, size, and weight of the battery or batteries, and the motor and the battery being separate components. The present invention provides a flywheel-type battery which is integrated within the motor within a lower housing and a housing lid. It provides an FBEV motor wherein the rotor windings are located on the interior and exterior of the peripherally mounted battery relative to the plane of the flywheel, making the battery, itself, in consort with the housing, the driving force of the motor.

Referring to Figs. 1 and 2 there is shown a perspective view and a plan view, respectively, of the inventive flywheel battery electrical vehicle system **10**, excluding the flywheel, having

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flywheel motor housing **12**, having in turn cylindrical housing wall **14**, having upper edge **16** and lower edge **18**, housing motor mounts **20** located at 90 degree intervals along lower edge **18**, and motor mount bracing flanges **21** extending upward along cylindrical housing wall **14**. Housing cover **22** features planar housing cover **23** extending along the cylindrical housing wall upper edge **16** and is connected to upper housing axial rotary bearing **26** by upper supporting flanges **24** and lower supporting flanges **25**. Upper housing axial bearing **28** is located at the upper end of upper housing axial rotary bearing **26**. Upper housing mounts(not shown) extend outwardly from housing planar cover **23** and are located around cylindrical housing wall **14** at **90** degree intervals, and are aligned with housing motor mounts **20**. As seen in Fig. 2, housing axial lower bearing **32** is aligned with upper housing axial rotary bearing **26** and is supported by lower housing bottom **34**, formed by triangular plates **35**. Depending wall **29** extends downward from planar housing cover **23**(see figs. 8 and 9)

Referring to Figs. 3 through 6, there is shown a plan view and an elevation view, respectively, of the flywheel rotary battery assembly **36**, and a plan view and sectional view along lines 6-6 of peripheral battery **38** with battery cover **41**. Peripheral battery **38** features battery casing outer wall **40** and battery casing inner wall **42**. Battery cover **41** encloses peripheral battery **38** and assures attachment and correct positioning of peripheral battery **38**. Stabilizing bearings **45** are located around the periphery of battery cover **41** and run in stabilizer track **81** located on the underside of

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planar housing cover **23**(see Figs. 8 and 9). Contact bearing pairs **47** are located at the periphery of peripheral battery support 60 and make periodic electrical contact with rotor coil bearing contact pairs **76** located in contact track **77**(see Fig. 7) as rotary battery assembly **36** rotates. Axially located axle **44** is connected with a peripheral battery support **60**(see Fig. 6) supporting peripheral battery **38**, by means of angled rotor braces **46**, so configured as to act as a cooling fan upon rotation of rotor battery assembly **36**. Inner rotor windings **48** are located along the battery casing inner wall **42** of peripheral battery **38** and outer rotor windings **50** are located along the outer wall **40** of peripheral battery **38**. They are electrically connected for activation with drive/charge computer through a wiring harness(not shown) which connects with axle **44** and individual brushes leading from axle **44** to the drive/charge computer. As shown in Fig. 4, rotary battery assembly **36** drives axle **44** which is the mechanical output of the flywheel battery electrical vehicle system **10**, which is connected to an appropriate hydraulic transmission(not shown). Axle **44** features main battery positive contact **54** and main battery negative contact **56** for brushes(not shown) connected to the drive/charge control computer, for input and output of electrical power to FBEV motor system **10**. Peripheral battery **38** is further contained by upper wall **58** and lower wall **59**.

Referring more particularly to Figs. 5 and 6, there is shown starved electrolyte lead acid peripheral battery **38** encased within battery cover **41** and having outer wall **40**, inner wall **42**, having

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upper wall **58**, and lower wall **59**, each wall preferably made of molded plastic. Peripheral battery **38** may be a single cell or divided into a plurality of cells, four cells **62** being shown, having battery mounting notches **64** located at 90 degree intervals along battery casing outer wall **40**, each mounting notch having a battery positive terminal **66**, and a battery negative terminal **68**, and each being connected to respective main battery contacts **54** and **56** by appropriate circuitry(not shown). Peripheral battery **38** is also held in place by mechanical uprights(not shown) projecting upward from peripheral battery support **60** and serve as connectors to positive terminals **66** and negative terminals **68**. A depiction of mounting notches and terminals **66** and **68** (see Fig. 6) are shown to illustrate their physical location relative to peripheral battery wall **40**. The starved electrolyte lead acid battery **38** consists of starved electrolyte paste between lead-copper plates of the battery to accommodate the high RPM that the battery will be spinning. Alternating battery positive plates **70** and battery negative plates **72** form alternate coaxial cylinders within the peripheral battery in the case of a single cell embodiment of the peripheral battery **38**, and partial alternate coaxial cylinders within the peripheral battery **38** in the case of multiple cells. Conventional battery design will not permit this type of movement because the liquid electrolyte would be pushed out by centrifugal force.

Referring to Fig. 7, there is shown a perspective view of cylindrical housing wall **14** with housing cover **22** and rotary battery system **36** removed, showing lower central axle aperture **73**

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formed collectively by triangular plates **35** at their lower intersection. Individual triangular plates **35** have apertures therethrough(not shown) which allow the passage of cooling air through FBEV system **10**. Outer stator windings **74** are located along cylindrical housing inner wall **75**. Rotor coil bearing contact pairs **76** are located in contact track **77** located at the base of cylindrical housing inner wall **75**.

Referring to Figs. 8 and 9 there are shown a bottom view and an elevation view, respectively, of the stator housing top assembly, where housing cover **22** has axial rotary bearing **26** and axial bearing end cap **28** centrally located therein and features coaxial depending wall **77** ending at lower edge **78**, and bearing inner stator windings **79** around its outer wall **80**. Stabilizer track **81** is located on the underside of housing cover **22** and provides a race for stabilizer bearings **45**(see Fig. 4). Apertures(not shown) are located in housing planar cover **23** between coaxial depending wall **77** and axle port **76** to allow cooling air to flow through the flywheel motor housing **12**.

Referring to Figs. 10 and 11 there are shown a front elevation view and a side elevation view(absent windings), respectively. Each outer rotor winding **50**(see Fig. 4) comprises horizontal cleat portion **82** and vertical cleat portion **86** supporting electrical wire coil winding **84** around electromagnet **88** by means of fasteners **90**. Horizontal cleat portion **82**, vertical cleat portion **86**, and electromagnet **88** may be of any suitable electromagnetic material, preferably steel, and may be an integral element. The structure of

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stator windings **50** are representative of all the stator and rotor windings of FBEV system **10**.

In operation, upon initial startup of FBEV system **10**, it is preferable that the FBEV motor still be attached to a charge station via a charge cord(not shown), thereby using an outside power source to start the motor, rather than using the vehicle's battery, The charge station provides conditioned 240-volt power for deep cycle charge. The charge cord, however, comes with an optional adaptor so that a 110 volt receptacle can be used for supplemental charging. The drive/charge control computer(not shown) senses voltage differences and charges the battery accordingly.

This initial startup can be done from the vehicle, itself, or from a remote control device. The remote control allows the operator to turn on the vehicle while he is still preparing to leave. The vehicle will be warmed up and ready for operation by the time he enters the vehicle.

Once operating RPM is attained (approximately 3600 RPM), a ready light on the vehicle's dashboard (not shown) changes from red to green, telling the operator the vehicle is ready to drive. This will take approximately three minutes.

Due to the weight of the flywheel, any time the motor is in an off/stop position, it requires a start-up/warm-up time of about three minutes.

During the warm-up period, the drive/charge control computer (not shown) activates some, but not all of the coils with pulsating

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current to start the flywheel in motion to conserve battery power when start-up is done away from the charge station. The field windings **74** and **79** are energized through sets of parallel contact bearings **47**, mounted around the circumference of the lower part of the housing **12**. Stabilizing bearings **45** and stabilizing bearing track **43** provide mechanical stability to the rotating rotary battery assembly. The housing cover **22** and lower housing **34** contain stabilizing track **43** and contact track **77**, respectively, each preferable made of Teflon® that the bearings ride on. Contact bearings **47** ride in contact track **77** having conductive contacts **76** set in pairs in specific locations to energize the field windings as desired and so located as to correspond with the bearings. Direct current is selectively supplied to these contact pairs through a wiring harness(not shown) from the drive/charge computer.

The rotor windings **48** and **50** of the rotary battery assembly 36 are selectively energized by the drive/charge computer using battery power or outside power by means of conductive brushes(not shown) on axle **44** along with the main battery contacts **54** and **56**. This allows constant current to flow to and from the battery and the rotor coil windings.

Once operating RPM is attained, the charge/drive control computer keeps the motor operating at an RPM between about 3600 and 4600 by energizing or de-energizing rotor windings and field windings as needed. There is a series of sensors and meters(not shown) that determine the speed of the vehicle to motor RPM ratio. If the vehicle is moving faster than the flywheel's potential

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power, for example during coasting, slowing down or going down-hill, these sensors and meters signal the drive/charge control computer that it is in a charge condition and the rotor windings **48** and **50** will become excitation windings by means of direct current supplied by brushes on the axle **44** to turn the stator windings **74** and **79** into power generating condition to charge the battery **38** by means of the wiring harness and the drive/charge computer.

During operation on battery power, the battery's current leaves the battery through main battery contacts **54** and **56** on the rotor's axle, goes through engaging brushes into the charge/drive control computer, which then transfers the current as needed through brushes on the axle to selected rotor windings and through a wiring harness to selected contact pairs to various field windings. Field windings **74** and **79** are provided with momentary electrical current through contact bearings **47** making momentary contact with rotor coil bearing contacts selectively energized by the computer, forming collapsing magnetic fields which interact with rotor windings **48** and **50** to form an electric motor. During operation, the motor is cooled by airflow caused by the rotor braces **46** being offset to create a fan-like environment and the upper housing **22** and lower housing **34** are louvered(not shown) to permit airflow.

Upon shutdown, two conditions apply. When shutdown takes place away from charge stations, the momentum of the peripheral battery assembly **36** is used to charge the battery **38** until its momentum stops and shutdown is complete. When shutdown occurs at

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a charge station, the charge cord will supply charge current to the battery **38**. Then the rotary battery assembly **36** will just spin freely until it slows down and stops.

It is to be understood that the present invention is not limited to the embodiments described above, but encompasses any and all embodiments within the scope of the following claims.

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